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Research Article

Effect of Cow Based Bio-enhancers and Botanicals on Number of Branches, Dry Weight of Nodules and Yield of Soybean (*Glycine max* L.)

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ABSTRACT

An experiment was planned during the year 2018 and 2019 to study the effect of some cow based bio-enhancers and botanicals on number of branches per plant, dry weight of nodules and yield of soybean, at Instructional Farm, Junagadh Agricultural University, Junagadh, Gujarat. The soil of the farm was medium black calcareous clayey soil. The variety which was taken in the experiment was GJS-3. The experiment was designed in randomized block design having treatments Control (T_1), 100% RDF (T_2) (outside the organic plot), FYM @ 10 t/ha (T_3), FYM @ 5 t/ha + Panchgavya @ 3% as foliar spray at 30 and 60 DAS (T_4), FYM @ 5 t/ha + Banana Pseudostem sap @ 1% as foliar spray at 30 and 60 DAS (T_5), FYM @ 5 t/ha + Seaweed extract @ 3.5% as foliar spray at 30 and 60 DAS (T_6), FYM @ 5 t/ha + Cow urine @ 3% as foliar spray at 30 and 60 DAS (T_7), Vermicompost @ 4 t/ha (T_8), Vermicompost @ 2 t/ha + Panchgavya @ 3% as foliar spray at 30 and 60 DAS (T_9), Vermicompost @ 2 t/ha + Banana Pseudostem sap @ 1% as foliar spray at 30 and 60 DAS (T_{10}), Vermicompost @ 2 t/ha + Seaweed extract @ 3.5% as foliar spray at 30 and 60 DAS (T_{11}) and Vermicompost @ 2 t/ha + Cow urine @ 3% as foliar spray at 30 and 60 DAS (T_{12}) shown good results regarding number of branches per plant, dry weight of nodules (mg) and yield of soybean. it was observed that during organic cultivation of soybean, application of Vermicompost @ 4 t/ha performed better results which was significantly at par with treatments FYM @ 10 t/ha, Vermicompost @ 2 t/ha + Panchgavya @ 3 % as foliar spray at 30 and 60 DAS and FYM @ 5 t/ha + Panchgavya @ 3% as foliar spray at 30 and 60 DAS. Although, inorganic application of fertilizer was performed best over to other treatments, but here we are considering the organic cultivation.

Keywords: *Soybean, FYM, Vermicompost, Panchgavya, Banana pseudostem sap, Seaweed extract, organic farming.*

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INTRODUCTION

It has been reported by many scientists that Soybean *(Glycine max* L.) is the most important and common oilseed crop among all the oilseed crops of world. It has capability to perform good even under severe stress (stress) conditions. It improves soil fertility by fixing atmospheric nitrogen (50-60 kg/ha), depending on the agro-climatic conditions, variety, strains, *etc.* soybean is well known for its nutritional and health benefits. It contains about 40% good quality protein, 20% oil having about 85% unsaturated fatty acids including 55% polyunsaturated fatty acids (PUFA), 20-25% carbohydrates and almost no starch, 4-5% minerals, anti-oxidants and 2% phospholipids (Halwankar et al., 1992). Soybean protein is rich in amino acids like lysine, leucine, methionine and threonine. This crop is also considered as "poor man's meat". It is very much suitable diet for diabetic patients. With the evolution in agriculture use of inorganic fertilizer increase the production but beside gives good yield it deteriorates the soil physical, chemical and biological properties of soil. Therefore, it is necessary to minimize the application of inorganic fertilizers by substituting with organics. The application of organic liquid such as *Panchgavya* and *Jivamrut, Bijamruth* enhance the growth, yield, and quality of crops and also maintain the soil health. *Panchgavya* is an efficient plant growth stimulant that enhanced the yield and improved biological efficiency of the crop (Gore & Sreenivasa, 2011). Use of both the substances (Banana pseudostem sap and seaweed extract) increase nutrient uptake from the soil and enhance antioxidant properties, they help in improve the growth and development of plants. Cow urine is a good source of nitrogen to plant growth and development.

MATERIALS AND METHODS

A field experiment was planned in a randomized block design during 2018 and 2019 at Instructional Farm, Junagadh Agricultural University, Junagadh (Gujarat). The soil of the experimental area was medium black calcareous clayey with medium in organic carbon and slightly alkaline (pH 8.1 and 7.7) in nature and the status of N was low, P_2O_5 and K_2O content of soil were medium. The total treatment combinations that had been taken was twelve with three replication *i.e.* Control (T_1), 100% RDF (T_2) (outside the organic plot), FYM @ 10 t/ha (T_3), FYM @ 5 t/ha + *Panchgavya* @ 3% as foliar spray at 30 and 60 DAS (T_4), FYM @ 5 t/ha + Banana Pseudostem sap @ 1% as foliar spray at 30 and 60 DAS (T_5), FYM @ 5 t/ha + Seaweed extract @ 3.5% as foliar spray at 30 and 60 DAS (T_6), FYM @ 5 t/ha + Cow urine @ 3% as foliar spray at 30 and 60 DAS (T_7), Vermicompost @ 4 t/ha (T_8), Vermicompost @ 2 t/ha + *Panchgavya* @ 3% as foliar spray at 30 and 60 DAS (T_9), Vermicompost @ 2 t/ha + Banana Pseudostem sap @ 1% as foliar spray at 30 and 60 DAS (T_{10}), Vermicompost @ 2 t/ha + Seaweed extract @ 3.5% as foliar spray at 30 and 60 DAS (T_{11}) and Vermicompost @ 2 t/ha + Cow urine @ 3% as foliar spray at 30 and 60 DAS (T_{12}). A seed rate of 60.00 kg/ha of variety 'GJS-3' was used for the experiment at a row spacing of 45 × 10 cm^2. No any kind of herbicide were used to control the weeds, two hand weeding were done manually during the crop season. The crop were irrigate as per requirement. *Panchgavya* was prepared at Instructional farm by using nine ingredients (cow dung, cow urine, cow milk, cow milk curd, cow ghee, coconut water, banana, water, jaggery).

RESULTS AND DISCUSSION

Effect on number of branches per plant

Data (Table-1) showed that different treatments exerted their significant effect on number of branches per plant at 30 DAS and 60 DAS. The maximum number of branches per plant (3.70 and 5.55 at 30 and 60 DAS, respectively) was recorded with application of 100% RDF (T_2) which was found statistically at par with Vermicompost @ 4 t/ha (T_8), FYM @ 10 t/ha (T_3), Vermicompost @ 2 t/ha + *Panchgavya* as foliar spray @ 3% at 30 and 60 DAS (T_9) and FYM @ 5 t/ha + *Panchgavya* as foliar spray @ 3% at 30 and 60 DAS (T_4)., &

minimum number of branches per plant (2.08 and 3.47 at 30 and 60 DAS, respectively) was registered under the control (T_1). Among organic cultivation, application of Vermicompost @ 4 t/ha gave highest number of branches per plant.

The increase number of branches per plant might be due to favourable influence of nitrogen in cell elongation and cell division which improves vegetative growth. Application of phosphorus enhance the various metabolic and physiological processes and thus known as "energy currency" which is subsequently used for vegetative and reproductive growth through photo-phosphorylation. When discussing about different cow based bio-enhancers and botanical treatments, Vermicompost performed better because of it is rich in NPK, different plant hormones and micronutrients, which regulates plant metabolism at cellular level and cast produced by worm feeding on organic substrates are extremely homogenous, fertile material suitable for plant growth. Vermicompost also increases the activities of urease, phosphatase and dehydrogenase, which results in higher metabolic activities. Bajracharya and Rai (2009), Ghanshyam and Jat (2010), Chaitnya et al. (2013), Devi et al. (2013), Rana and Badaliya (2014) and Chaudhary et al. (2015).

Effect on dry weight of nodules per plant

Data (Table-1) revealed that different treatments exerted their significant effect on dry weight of nodules (mg) per plant. Application of Vermicompost @ 4 t/ha (T_8) recorded highest dry weight of nodules per plant (332.83 mg/plant and 1759 mg/plant at 30 and 60 DAS, respectively), which was comparable to FYM @ 10 t/ha (T_3) and 100% RDF (T_2). However, the lowest dry weight of nodules per plant (192.50 mg/plant and 1224 mg/plant at 30 and 60 DAS) was registered under the control (T_1). Vermicompost increases the population of beneficial microorganisms into the rhizosphere of plant which enhances the nitrognease enzyme responsible for N fixation of atmospheric N in legumes. This in turn enriches the N status of soil, thereby increasing the availability of N. Vermicompost provides food for the bacterial growth and metabolic activities and presence of higher amount of hormones and balanced pH, maintain the favourable environment results in maximum growth of bacteria present in root nodules might be the reason of highest dry weight of root nodules. Similar findings have been reported by Das et al. (2002), Bajracharya and Rai (2009), Ghanshyam and Jat (2010), Chaitnya et al. (2013), Devi et al. (2013), Rana and Badaliya (2014) and Chaudhary et al. (2015).

Effect on yield

Scrutiny (Table-1) of data revealed that different treatments exercised their significant influence on seed yield. The highest seed yield (2509 kg/ha) was noted with an application of 100% RDF (T_2), which remained statistically at par with Vermicompost @ 4 t/ha (T_8), FYM @ 10 t/ha (T_3), Vermicompost @ 2 t/ha + *Panchgavya* as foliar spray @ 3% (T_9) and FYM @ 5 t/ha + *Panchgavya* as foliar spray @ 3% at 30 and 60 DAS (T_4). However, significantly the lowest seed yield (1398 kg/ha) was registered under control (T_1). Under organic cultivation application of Vermicompost @ 4 t/ha gave highest yield (2463 kg/ha). More availability of photosynthates, metabolites and nutrients to the plants helps in development of good reproductive structure, phosphorus is considered as energy-currency, that's why it is essential for the general health and vigour of all plants. In case of organic cultivation vermicompost provides better soil environment, which encouraged proliferation of plant roots, which helped to absorb more water and nutrients from larger area and deeper layers and thus owing to higher availability of nutrients, synthesis of more carbohydrates and their translocation to different plant parts resulted increased vegetative growth including the reproductive structures. These findings are in conformity with the Das et al. (2002), Jat and Ahlawat (2004), Ghanshyam and Jat (2010), Mycin et al. (2010), Paliwal et al. (2011), Vasoya (2014), Chaudhary et al. (2015) and Khan et al. (2017).

Table 1: Effect of different treatments on number of branches per plant, dry weight of nodules per plant and seed yield of soybean

Treatment	No. of branches/plant		Dry weight of nodules(mg)/plant		Seed Yield (kg/ha)
	30 DAS	60 DAS	30 DAS	60 DAS	
T_1	2.08	3.47	192.50	1224	1398
T_2	3.70	5.55	308.00	1719	2509
T_3	3.33	5.18	312.67	1741	2370
T_4	3.17	4.93	244.00	1378	2324
T_5	2.65	4.62	218.00	1307	1935
T_6	2.23	4.43	215.00	1298	1852
T_7	2.72	4.72	222.17	1359	2065
T_8	3.48	5.35	332.83	1759	2463
T_9	3.18	5.03	286.17	1568	2333
T_{10}	2.70	4.65	274.00	1436	2009
T_{11}	2.57	4.57	256.50	1383	1898
T_{12}	2.75	4.73	284.43	1457	2074
S.Em.±	0.14	0.17	8.76	49.13	102
C.D. at 5 %	0.41	0.48	24.97	140.03	290.22
C.V. %	12.24	8.69	8.18	8.19	11.86
Y x T					
S.Em.±	0.20	0.24	12.39	69.48	144.00
C.D. at 5 %	NS	NS	NS	NS	NS

Data presented in the table are Pooled data of both (2018 and 2019) the years.

CONCLUSION

Adoption of organic farming by using some cow-based bioenhancers and botanicals for the cultivation of soybean might be a good option. Other than alone application of Vermicompost @ 4 t/ha, application of FYM @ 10 t/ha also performed better. Although application of inorganic fertilizer was just taken to compare the results with organic, performance of inorganic was good.

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